

# Petroleum Products

---

---

---

---

---

---

---

---

## What is petroleum?

- Also known as crude oil
- It is a thick black sludge
- It comes from ancient plant and animal life long since buried and kept under extreme pressure for millions of years.
- It is composed of countless different organic compounds.

---

---

---

---

---

---

---

---

## What is made from petroleum

- Gasoline, kerosene, and rocket fuel
- Most plastics and other polymers (elastomers and fibers)
- Synthetic rubbers and fabrics
- Most pharmaceutical drugs
- And several other things
- If we run out of petroleum it would have a devastating effect on us

---

---

---

---

---

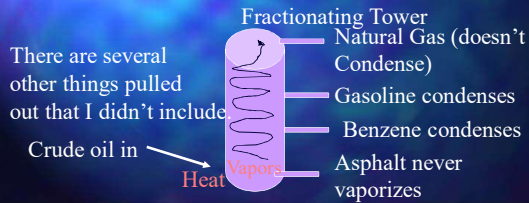
---

---

---

## Petroleum is separated in a fractionating tower

- Fractionating Tower- structure where crude oil is heated to boiling and different structures are collected at different temperatures.



---

---

---

---

---

---

---

---

## How a fractionating tower works

- Inside the tower is a serpentine pathway for the vapors to climb up.
- As the vapors get further away from the heat source some of the different compounds condense at different temperatures.
- Each layer has a valve to allow vapors to rise up, but a drain tube to collect any liquids that condense.

---

---

---

---

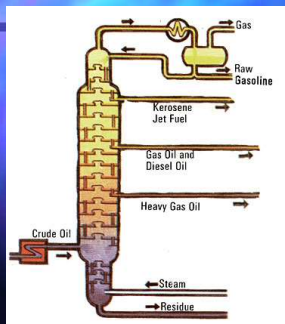
---

---

---

---

## These are BIG!!



---

---

---

---

---

---

---

---

## One compound that comes from petroleum

Benzene

Which changes to...



It also is drawn as



And back again constantly  
Double bonds  
Are a little shorter  
Than single bonds  
But in benzene all  
Bonds are the  
Same length.

---

---

---

---

---

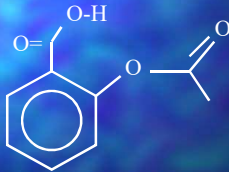
---

---

---

## Compounds that contain benzene are called aromatic

- Aspirin (acetyl salicylic acid)



---

---

---

---

---

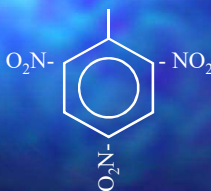
---

---

---

## Compounds that contain benzene are called aromatic

- Trinitro Toluene (TNT)



---

---

---

---

---

---

---

---

## A few other aromatics

- Vinyl, naphthalene (found in moth balls), acetaminophen, penicillin
- Benzene is an extremely common organic compound
- The fact that the double bonds flip back and forth (called resonance) give it a very stable structure

---

---

---

---

---

---

---

---

## IUPAC vs. Common and copyrighted names

- Several compounds have names similar to what we went over but slightly different.
- Common names for several compounds have been around for centuries and are still used (acetic acid, formaldehyde)
- Several other names were copyrighted for sale (acetaminophen and polypropylene)

---

---

---

---

---

---

---

---

## To burn or to build?

- Burning hydrocarbons normally produces carbon dioxide.
- As our fossil fuels use has increased, so have our CO<sub>2</sub> levels.
- Petroleum products are used to produce several fuel sources as well as polymers.

---

---

---

---

---

---

---

---

# Polymerization

---

---

---

---

---

---

---

---

## Polymers

- Polymers are large chain like molecules made of smaller molecules called monomers.
- Monomers must have ends that can chemically bond together and make new molecules that can still bond together.
- For example  $A + B \rightarrow C$
- $A \square B + A \square B \rightarrow A \square C \square B$
- Notice the new molecule still has an A and B end so it can keep on bonding to the original monomers and make a polymer that looks like
- $A \square C \square C \square C \square C \square C \square C \square C \square C \square C \square B$

---

---

---

---

---

---

---

---

## A functional group we did not cover...

- Esters- a functional group in the middle of a carbon chain;  $R-COO-R$
- It gets the suffix -oate (you won't have to name these!)

the water came from...

$$\begin{array}{c}
 R-C-O-R \\
 \parallel \\
 O
 \end{array}
 +
 \begin{array}{c}
 H-O-R \\
 | \\
 H
 \end{array}
 \rightarrow
 \begin{array}{c}
 R-C-O-R \\
 \parallel \\
 O
 \end{array}
 + H-O-H$$

It is very similar to carboxylic acids  
~In fact it is formed by a carboxylic acid and an alcohol

---

---

---

---

---

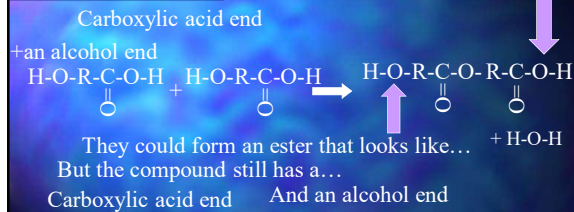
---

---

---



Now if you have a few compounds that have both a



So it could keep repeating...

---

---

---

---

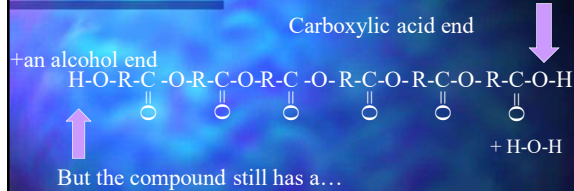
---

---

---

---

So this could keep happening



So it could repeat this process thousands even millions of times and make a whole bunch of... **polyesters**

Of course the scientific prefix for "whole bunch of" is

---

---

---

---

---

---

---

---

**Polyester** is one example of a polymer

- The important thing is that the new molecule can still bond with the other monomers present.
- **Monomers need to have ends that can bond together** (or stack on top of one another).
- In polyester, that was a carboxylic acid end and an alcohol end, but monomers for other polymers have different ends. As long as the ends can bond together.

---

---

---

---

---

---

---

---

## Polymers can get very large

- Monomers could (infinitely) join together to make a very large polymer.
- common polymers have a molecular mass of around 50,000 g/mol.
- The first molecules seen under a microscope were polymer chains.
- Common polymers include things like...
- Nylon, Kevlar®, latex, PVC, rubber, acrylic, vinyl, Deoxyribonucleic acid (DNA) and carbohydrates

---

---

---

---

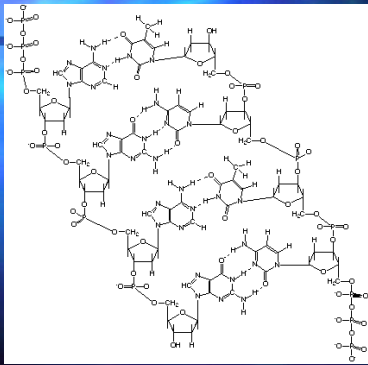
---

---

---

---

## Piece of DNA



---

---

---

---

---

---

---

---

## Polymers are put into three classes

Elastomers-	Fibers	Plastics
Polymers that can be stretched to 10x their normal size and return to their original shape	Polymers that cannot stretch or be reshaped once formed	Polymers that can stretch and flex more than fibers but less than elastomers
Elastic	Nylon and Acrylic	Polypropylene polystyrene and PVC (polyvinyl chloride)

---

---

---

---

---

---

---

---

## Polymer/Polymer Science

- Polymer Science is a field of **material chemistry**, which looks at improving the material we use to make things.
- In this field, scientists are paying close attention to how changes in monomers can make exciting new materials.
- They couldn't imagine jumping out of an airplane until nylon had been invented to make parachutes. Who would stand in front of a bullet wearing only a vest before Kevlar?
- University of Akron has a polymer institute.

---

---

---

---

---

---

---

---